THE INFLUENCES OF EXPLOATATION OF COLOURED METALS ON THE ENVIRONMENT

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ABSTRACT

The pollution of the environment in the last few decades has been the subject with least attention, but the last few years this topic has a priority. The issue of the presence of hard and toxic metals in the waters is of special interest.

We can witness the changes of the environment that man imposes with its existence and functioning, which sustain a greater degradation every day and we may not be very far from the truth that our planet will become a dangerous place for living.

We should not forget that the environment is the only place to live and work not only for the present but also for the future generations and we should not allow man's interventions in the nature to lead to its complete destruction.

A great number of problems related to the pollution of the environment are connected with the mining activities. The nature of the pollution depends on the extracted materials and their further processing. The mines for lead and zink (Sasa, Zletovo, Toranica), copper (Buchim), iron and nickel (Rzanovo) are the main polluters. Even though more prevailing and numbered, the exploitation of the building stone, gravel and sand, is far less significant from a chemical aspect of pollution.

Both the surface digging sites and the underground mining operations, usually spread under the level of underground waters, which very often requires large drainage capacities in order to enable the progress in mining.

The mining waters are usually highly mineralized, with low pH value (up till 3), high content of iron, copper, lead, zink, aluminum and sulfats. The outflow of the mining waters into the surface and underground waters can initiate serious consequences on the quality of the water and the environment itself.

This paper presents the influence of the mining activity on water, air, earth and noise occurrence.

Key words: *mining activity, environment, pollution, soils, hard metals, Sasa Mine, Buchim Mine.*

1.0 Introduction

The impact of mining activities on the surrounding occurs almost in all phases of the mining cycle, from site preparation, excavation, separation and ore processing. It includes water evacuation in order to supply water for the mine, separation and outflow of water from the tailing dump.

Environmental pollution caused with mining activities includes contamination with acid mine waters, heavy metals, chemical reagents disposed of after processing, discharge of materials as well as the separation and overflow of materials from the tailing dumps.

The cessation of mining activities does not put an end to pollution. On the contrary, pollution may last for years after mine closure.

The negative effects of idle mines take place some time after cessation and draw of water from the mine. Ground waters whose level has lowered after draw of water begin reaching the earlier level. Water floods the mine and flows into the valleys and rivers through drifts.
Mining industry plays an enormous role among anthropogenic activities especially being one of those that have a negative impact on the ecosystem. It is well known that this negative impact is lager during mineral preparation and processing than during the recovery process. The effects of mineral raw material exploitation exceeds the area limits where the mines operate, causing changes in their close and distant surrounding.
The consequences from the harmful effects include degradation of the entire ecosystem by pollution and land, water and air degradation.
The paper will present the results obtained during the investigations carried out on the contents of heavy metals in the soils not far from the Buchim and Sasa Mines.

2.0 Results and discussion

The Buchim Mine is the only copper mine in the Republic of Macedonia. It is located close to Radovish (fig. 1). It has been in operation since 1979. Preliminary investigation results of this type can be found in the publications from Spasovski at al 2007 ([2]), Spasovski and Doneva (2007).
Results from sampling programmes of water and sediments from the watercourses of Topolnicka and Madenska River gave us a clue to proceed with a sampling programme of soils around those watercourses. The sampling programme was realized along profiles that were established normaly to the watercourses. Samples were taken approximately from 25 meters from the watercourse on both sides. After the sampling the samples followed the same procedure as it was mentioned in the Materials and methods part of the text.
The results that were obtained with an analysis of soil samples are given in Table 1.

Fig. 1. Map of the Republic of Macedonia with the location of the area under investigation

Table 1. *Concentrations of some metals in the soils along Topolnicka and Madenska River (mg/kg)*

Elements	T-1	T-2	T-3	T-4	T-5	T-6	Standard
Cu	216.84	290.21	150.55	210.41	1786.00	179.21	17.5
Ni	17.11	20.15	149.16	350.15	100.05	68.12	9.9
Mn	0.030	0.050	0.102	0.089	0.090	0.086	
Cr	50.79	60.42	72.50	200.25	105.04	56.03	10
Zn	46.86	48.66	89.14	102.20	80.5	79.61	22.5
Pb	39.14	18.42	146.18	116.42	32.62	126.73	10.5
Co	18.35	22.16	21.15	26.11	22.15	14.42	10
As	16.21	24.12	4.12	14.06	1.20	6.22	1.1
V	72.00	84.43	49.69	50.13	66.10	50.16	50

Cu – copper have shown concentrations higher than standard values in all samples.It is consequence of geology of the area, but mostly anthropogene factor have contributed significantly. Maximum concentration was determined in sample T-5.
Ni – its presence in the mineral association as trace element causes very high concentrations in analyzed samples. Beside the presence in the mineral association its very high concentrations are because of application of organic fertilizers in the area.
Mn – this element have shown concentrations few times higher than those allowed by standards. It should be pointed out that these samples were sampled from arable soils treated by organic fertilizers, which increased the concentration of Mn.
Cr –chromium behaviour is similar as it was case with nickel. It reaches its maximum value in the T-4
Zn – because of the geology of the area. Zn bee determined in very high concentrations, especially in samples taken near the mine. Extremely high concentrations were determined in samples T-4 as a direct consequence of the antropogenic factor.
Pb – in most of the samples its concentrations were higher than the standard values.
Co – in all samples was determined increased presence of this element, above the standard values. The maximum value was determined in sample T-4.
As – as a direct consequence of geology of the samoled area arsenic was determined in concentracions higher than standard values. The highest concentration of arsenic was determined sample T-2.
V – in present in mineral association in the area, which have been demonstrated by high concentration in soil samples. Its highest concentration has been determined sample T-2
The Sasa lead and zinc mine and the site for disposal of the tailings after the flotation process are located 10 km north of Makedonska Kamenica (fig. 1).
Preliminary investigation results of this type can be found in the publications from Mircovski, Spasovski at al., 2004 ([1]), Spasovski and Doneva, 2007 ([3,4]), Spasovski and Mitev 2009 ([5]).
Results from sampling programmes of water and sediments from the watercourses of Kamenicka River gave us a clue to proceed with a sampling programme of soils around those watercourses. The sampling programme was realized along profiles that were established normaly to the watercourses. Samples were taken approximately from 25 meters from the watercourse on both sides. After the sampling the samples followed the same procedure as it was mentioned in the Materials and methods part of the text.
The results that were obtained with an analysis of soil samples are given in Table 2.
Zn – because of the presence of the Sasa mine and the geology of the area Zn has been determined in anomalously hugh concentrations in all samples taken near the mine.

Pb – as well as for the Za, Pb in present in increased concentrations than the standard values in all samples.
Cd – the very toxic cadmium showed very high values almost in all samples, except in two. All of them are few times above the standard values. This fact point out to a very serious contamination with this metal.
Co – in all samples was determined increased presence of this element, obove the standard values. The maximum value was determined in sample Kr-5.

Table 2. *Concentrations of some metals in the soils along Kamenicka River (mg/kg)*

Elements	Kr-1	Kr-2	Kr-3	Kr-4	Kr-5	Kr-6	Standard
Pb	53.49	25.04	57.49	74.48	66.98	112.98	10.5
Zn	512.42	70.01	307.14	613.71	135.16	452.55	22.5
Cd	512.42	0.04	3.20	4.85	0.10	2.54	0.2
Co	12.97	15.96	12.75	15.27	17.95	17.55	10
As	6.53	27.66	10.83	40.68	34.52	62.31	1.1
Cr	27.48	38.10	23.46	35.01	39.27	31.91	10
Cu	26.22	24.68	27.95	32.81	42.87	33.18	17.5
Ni	22.79	19.58	23.32	30.01	36.73	34.02	9.9

As – as a direct consequence of geology of the sampled area arsenic was determined in concentrations higher than standard values. The highest concentration of arsenic was determined in sample Kr-6.
Cr – as well as Ni, Cr concentrations are also 2-3 times over the standard values.
Cu – copper have shown concentrations higher than standard values in all samples. Maximum concentration was determined in sample Kr-5.
Ni – its presence is in very high concentrations in analyzed samples. Its concentrations are 2-3 times over the standard values.
The main reasons for increased pollution of soils in the area of interest should be the geology and composiotion of rocks and mineralizations, organic fertilizers used on arable soils, etc. (Younger, 2002a, 2002b).
In general, after summarizing all the facts, which have resulted from this research we could say that, due to intensive mining in the Sasa Mine during the previous years, was determined serious disturbance of the natural metal balance in medias such as sediments and soils.

Conclusion

The impact of mining activities on the surrounding occurs almost in all phases of the mining cycle, from site preparation, excavation, separation and ore processing. It includes water evacuation in order to supply water for the mine, separation and outflow of water from the tailing dump.
The results obtained from the studies carried out on samples collected from soils yielded increased heavy metal concentrations of Pb, Zn, Cu, Mn, Cd, As, Ni, Fe, Co etc.
Increased concentracions of heavy and toxic metals are direct consequence of few factors: geological composition of the area, anthropogenic influences such as mining, miling and deposition of tailing, application of organic feltirizers on arable soils.
The high As, Cd, Cu, Pb, Zn, Mn concentrations in the soils have been found in the valleys of the Rivers Kamenicka, Topolnicka and Madenska. It is believed that the pollution in the area may spread into neighbouring countries (Greece for example) through the Kamenicka, Madenska, Topolnicka, Bregalnica and River Vardar courses.

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